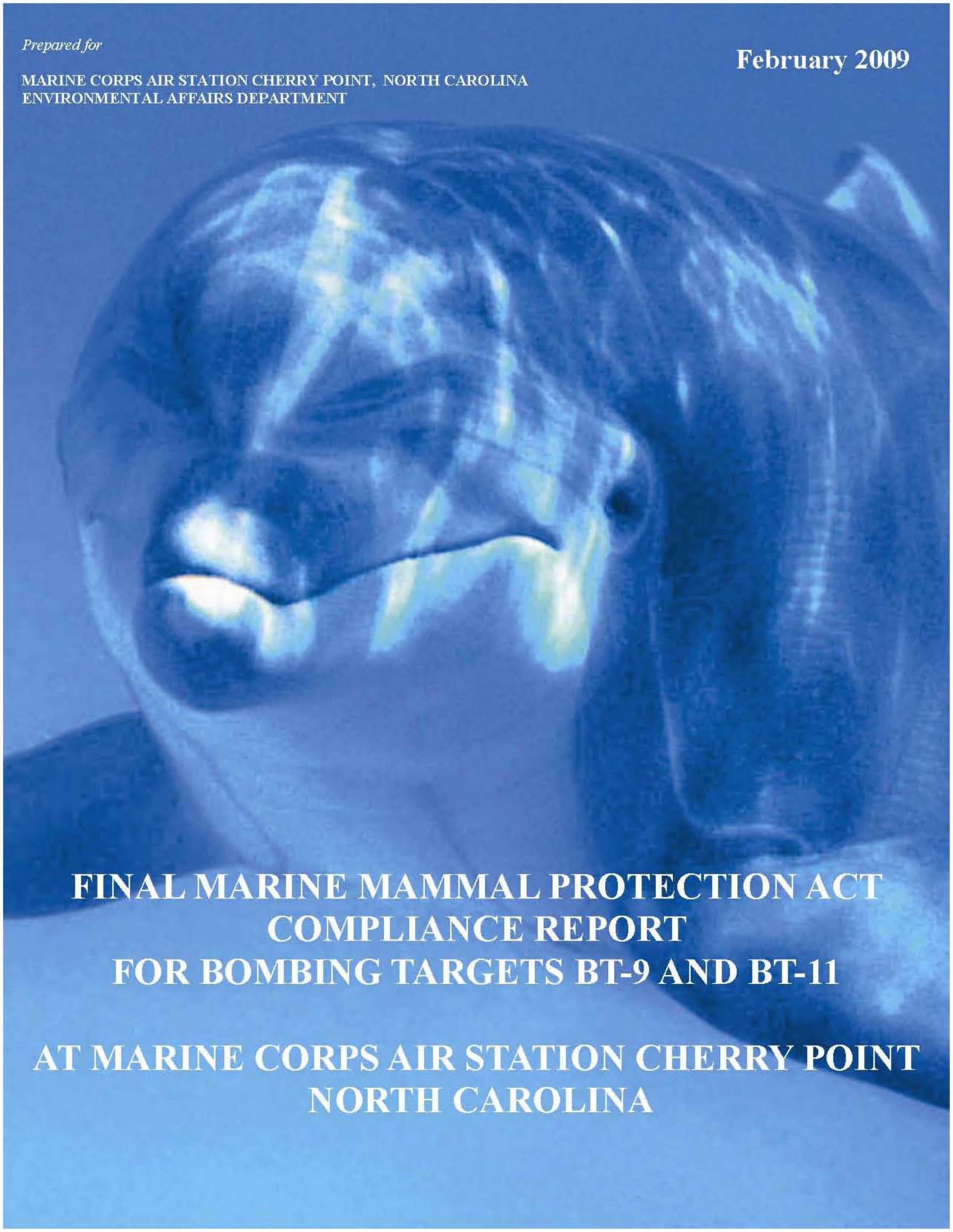

Prepared for

MARINE CORPS AIR STATION CHERRY POINT, NORTH CAROLINA
ENVIRONMENTAL AFFAIRS DEPARTMENT

February 2009

FINAL MARINE MAMMAL PROTECTION ACT COMPLIANCE REPORT FOR BOMBING TARGETS BT-9 AND BT-11

AT MARINE CORPS AIR STATION CHERRY POINT NORTH CAROLINA

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MARINE MAMMAL PROTECTION ACT COMPLIANCE REPORT FOR ACTIVITIES AT MARINE CORPS AIR STATION CHERRY POINT, NORTH CAROLINA

FINAL REPORT

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

BT	Bombing Target
°C	Degree(s) Celsius
cal	Caliber
CETAP	Cetacean and Turtle Assessment Program
CFR	Code of Federal Regulations
Cm	Centimeters
CURRS	Consolidated Utilization Range Report System
dB	Decibel
dB re: 1 μPa	Decibels with reference pressure of one microPascal
dB re 1 μPa^2-m	Decibels with reference to microPascals squared per meter
dB re 1 μPa^2-s	Decibels with reference to microPascals squared per second
DoN	Department of the Navy
EFD	Energy flux density
ESA	Endangered Species Act
°F	Degree(s) Farenheit
FEIS	Final Environmental Impact Statement
FLMI	Florida Marine Research Institute
ft	Foot
FY	Fiscal year
HE	High explosive
hz	Hertz
in	Inches
in-lb/in^2	Inch-pound per square inch
kg	Kilogram (s)
kHz	kiloHertz
km	Kilometer (s)
km^2	Square kilometer(s)
lb(s)	Pound (s)
LGTR	Laser Guided Training Round
m	Meter(s)
m^2	Square meter(s)
MCAS	Marine Corps Air Station
MMPA	Marine Mammal Protection Act
mi	Mile (s)
mi^2	Square miles
mm	Millimeter (s)
msec	Millisecond
MU	Management Unit
N/A	Not applicable
NC	North Carolina
NCWM	North Carolina Winter Mixed
NEW	Net explosive weight
nm	Nautical mile(s)
NM	Northern Migratory
NMFS	National Marine Fisheries Service
NNC	Northern North Carolina
NOAA	National Oceanic and Atmospheric Administration

List of Acronyms, Abbreviations and Symbols

OTO	One-third-octave
psi	Pounds per square inch
psu	Practical salinity unit
PTS	Permanent threshold shift
SAMs	Surface-to-air missiles
SM	Statute-mile
SNC	Southern North Carolina
sq ft	Square feet
sq km	Square kilometers
sq mi	Square miles
TL	Transmission loss
TM	Tympanic membrane
TNT	Trinitrotoluene
TTS	Temporary threshold shift
U.S.	United States
USC	U.S. Code
USFWS	U.S. Fish and Wildlife Service
USMC	U.S. Marine Corps
ZOI	Zone of Influence

1. DESCRIPTION OF ACTIVITIES

1.1 INTRODUCTION

The United States Marine Corps (USMC) has prepared this Marine Mammal Compliance Report in accordance with the applicable regulations and the Marine Mammal Protection Act (MMPA), as amended by the National Defense Authorization Act for Fiscal Year 2004 (Public Law 108-136). This report analyzes the potential effects to marine mammals associated with bombing and target training within two in-water bombing targets (BTs) located in Pamlico Sound, North Carolina (NC), also known as the Brant Island Target (BT-9) and the Rattan Bay BTs of the Piney Island Bombing Range/Complex (BT-11) (Figure 1-1). These bombing targets are under the control and management of Marine Corps Air Station (MCAS), Cherry Point.

The MMPA of 1972, as amended (16 United States Code [USC] Section [§] 1371[a][5][A] and [D]), authorizes the issuance of regulations, Letters of Authorization (LOAs), and Incidental Harrassment Authorizations (IHAs) for the incidental taking of marine mammals by a specified activity. The issuance of an LOA or IHA occurs when the Secretary of Commerce, after notice has been published in the Federal Register and opportunity for comment has been provided, finds that such takes will have a negligible impact on the species and stocks of marine mammals and will not have an unmitigable adverse impact on their availability for subsistence uses. The National Marine Fisheries Service (NMFS) has promulgated implementing regulations under 50 Code of Federal Regulations (CFR) § 216.101–106 that provide a mechanism for allowing the incidental, but not intentional, taking of marine mammals while engaged in a specified activity.

The United States Marine Corps (USMC) proposes to support and conduct operations at the MCAS Cherry Point Range Complex (Figure 1-1). Emerging training requirements reflect an increase in the amount of training operations conducted. Some of the mission increases and current training activities are not relevant to this compliance document as they have no potential to affect marine mammals. Thus, the focus of this document includes only those training missions occurring on the water ranges or with impact areas over the water because of their potential to affect marine mammals. These missions include:

- **Munitions Firing.** Units conduct air-to-ground, surface-to-surface, and air-to-surface munitions delivery at targets that are located on land or in water. Air-to-ground firing does not impact the water and is not analyzed or discussed further in this document.
- **Small Boat Maneuvers.** Units operate Small Unit River Craft, Combat Rubber Raiding Craft, Rigid Hull Inflatable Boats, Patrol Craft, and many other versions of these types of boats. These boats use inboard or outboard engines with either propeller or water jet propulsion.

Water range areas addressed within this report include the BTs located in Pamlico Sound, NC, known as the Brant Island Target (BT-9) and the Rattan Bay BTs of the Piney Island Bombing Range/Complex (BT-11) [Figure 1-1]. These BTs are used to train military personnel to deliver ordnance on a target. Ordnance is primarily delivered from aircraft but is also occasionally delivered from small military watercraft. Table 1-1 provides a general description of the training activities and munitions used on BT-9 and BT-11.

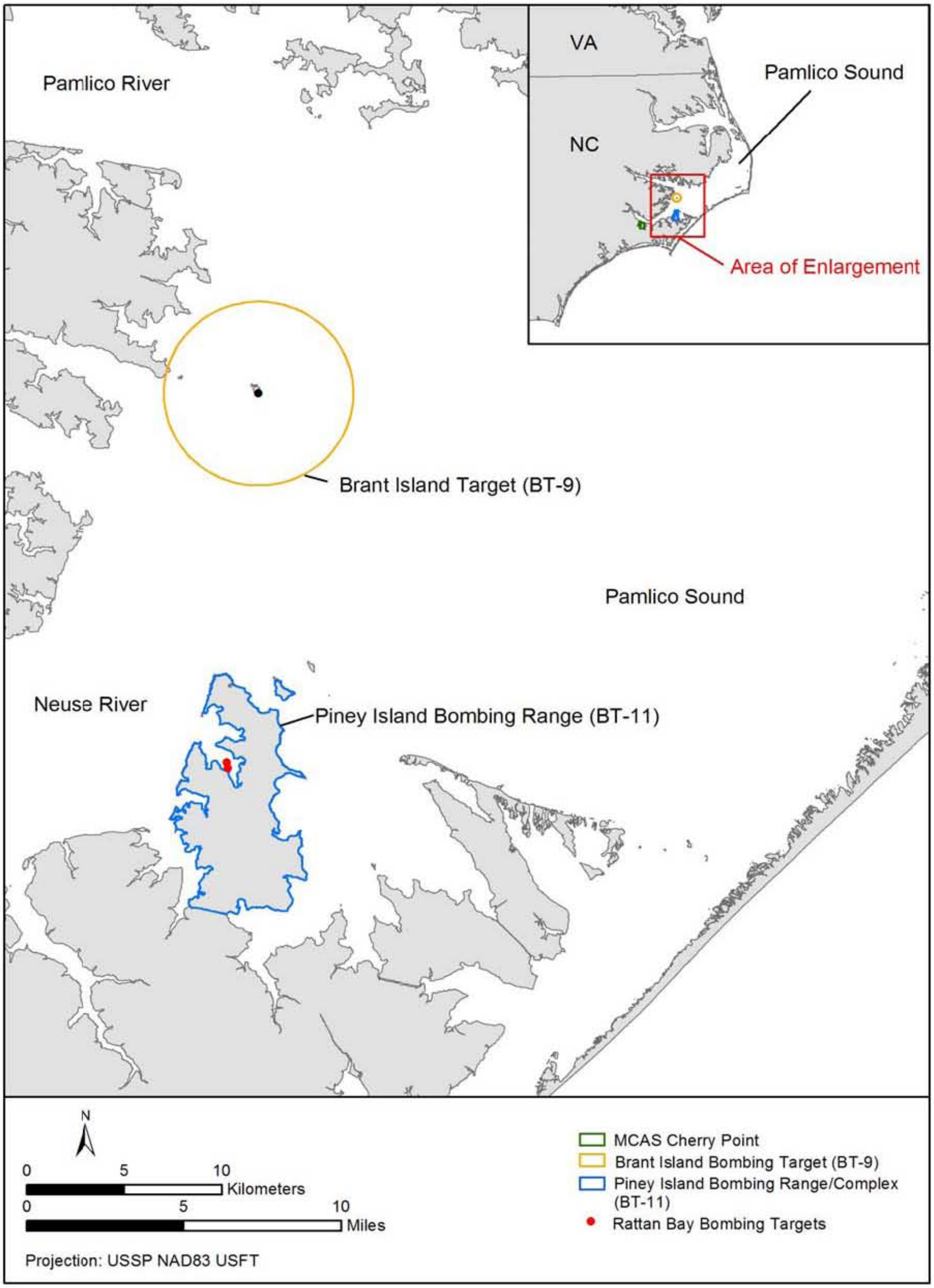

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Figure 1-1. MCAS Cherry Point bombing targets BT-9, Brant Island Bombing Target, and BT-11, Piney Island Bombing Range/Complex (33 CFR 334.420; USMC 2001b).

Table 1-1. MCAS Cherry Point Water Training Range Descriptions

Range Asset	Training Operation	Type of Munitions Used
BT-9 (Brant Island Target)	Water-based target range for air-to-surface and surface-to-surface warfare training, including bombing, strafing, special (laser systems) weapons, and surface fires, using non-explosive and explosive ordnance; also provides a mining exercise area	Small Arms, Large Arms (live and inert), Bombs (live and inert), and Pyrotechnics
BT-11 (Piney Island Bombing Range)	Complex of land- and water-based targets designed to provide training in the delivery of conventional (non-explosive) and special (laser systems) weapons; secondary use for surface-to-surface training by small military watercraft	Small Arms, Large Arms (inert), Bombs (inert), and Pyrotechnics

The following subsections provide detailed information about the three MCAS Cherry Point mission categories analyzed within this compliance report. Chapter 2 provides specific information about the geographic location of this training.

1.2 MUNITIONS FIRING

Munitions firing training conducted on the water ranges include surface-to-surface firing (from ship or boat to surface targets) and air-to-surface firing (from aircraft to surface water targets). This activity occurs year round with no seasonal restrictions. There are many types of ordnance used at BT-9 and BT-11 including practice bombs, rockets, flares, chaff, gun ammunition, and grenades (Table 1-2 and Appendix A). Explosive ordnance is authorized only at BT-9; the standard operating procedure sets the maximum limit of 100 pounds (lbs) trinitrotoluene (TNT) equivalent for explosive ordnance at BT-9. Net explosive weights (NEW) used at BT-9 range from 0.1019 to 15 lbs.

Practice bombs are non-explosive and are used at both targets. Lighter practice bombs (less than 500 lbs) contain a small amount of an explosive marking charge in a signal cartridge that allows the target hit to be detected by range scorekeepers and the pilot. Explosives in the signal cartridge are less than 1 lb TNT equivalent (USMC 2001a). Table 1-2 lists the types of munitions expended at the MCAS Cherry Point Range Complex. It should be noted that all munitions fired on the BT-11 range are non-explosive with the exception of the small explosives in the single charges.

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Table 1-2. Munitions Authorized for Use at the MCAS Cherry Point Range Complex.

Small Arms	Large Arms	Missiles[1]	Rockets	Bombs	Pyrotechnics
.22 cal-Live	20 mm-Inert	Hellfire	2.75-inch Rocket-Inert	G911 Grenade-Live	Chaff
5.56 mm-Live	25 mm-Inert	Tube-launched, optically tracked, wire-guided (TOW)	2.75-inch Rocket Illumination-Inert	Hand Grenade-Inert	LUU-2
7.62 mm-Live	30 mm-Inert		2.75-inch Rocket White Phosphorous-Inert	Non-Lethal Stun Grenade-Inert	MI27A1-Parachute Flare
9 mm-Live	30 mm-Live		2.75-inch Rocket-Live	BDU-48 10 lb-Inert	Self Protection Flare
.40 cal-Live	40 mm-Inert		5-inch Rocket-Inert	BDU-33 25 lb-Inert	Signal Illuminations-Inert
.45 cal-Live	40 mm-Live		5-inch Rocket White Phosphorous-Inert	MK-48-Inert	Simulated Booby Traps-Inert
.50 cal-Live	40 mm Illumination-Inert		5-inch Rocket-Live	MK-76 25 lb-Inert	Smokey Sams
12 Gauge-Live	105 mm Target Practice-Inert			LGTR 90 lb-Inert	
	105mm 40 lb-Live			BDU-45 500 lb-Inert	
				BDU-50 500 lb-Inert	
				GBU-12 500 lb-Inert	
				MK-82 500 lb-Inert	
				BDU-38 750 lb-Inert	
				GBU-16 1,000 lb-Inert	
				MK-83 1,000 lb-Inert	

Note: 1. Two types of missiles, Hellfire and TOW, were previously approved for use at BT-9 per Air Station Order P3570.2R; however, use of these missiles at MCAS Cherry Point has been cancelled since Fiscal Year (FY) 2005 due to operational limitations imposed by an insufficient weapon safety footprint at the water range.

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1.2.1 Surface-to-Surface

Gunnery exercises are the only category of surface-to- surface activities currently conducted within the MCAS Cherry Point BTs.

- **Gunnery Exercise:** A small boat, typically operated by Special Boat Team personnel, uses a machine gun to attack and disable or destroy a surface target that simulates another ship, boat, swimmer, floating mine or near shore land targets. Boats conducting surface-to-surface firing activities will typically use 7.62 millimeter (mm) or .50 caliber (cal) machine guns; 40 mm Grenade machine guns or G911 Concussion hand grenades. This exercise is usually a live-fire exercise, but at times blanks may be used so that the boat crews can practice their ship handling skills. The most common exercise target used is BT-9. A target is not used for the G911 Concussion grenade, as the goal is to learn how to throw it into the water.

1.2.2 Air-to-Surface

There are four types of air-to-surface activities conducted within the MCAS Cherry Point BTs. These training activities are grouped into either mine laying; bombing; gunnery or rocket exercises.

- **Mine Laying:** These activities involve the use of a fixed wing aircraft deploying inert mine shapes in an offensive or defensive pattern. Mine laying operations are regularly conducted in the waters in the vicinity of BT-9.
- **Bombing Exercise:** During this exercise fixed wing aircraft deliver bombs against surface maritime targets, day or night, with the goal of destroying or disabling enemy ships or boats. Air-to-surface bombing exercises employ either unguided or precision-guided munitions. Unguided munitions include MK-76 and BDU-45 inert training bombs, and MK-80 series of inert bombs (no cluster munitions authorized). Precision-guided munitions consist of laser-guided bombs (inert) and laser-guided training rounds (inert).
- **Gunnery Exercise:** Rotary wing gunnery and fixed wing exercises are also conducted. Rotary wing exercises involve either CH-53, UH-1, CH-46, MV-22, or H-60 rotary-wing aircraft with mounted 7.62 mm or .50 cal machine guns. Each gunner expends approximately 800 rounds of 7.62 mm and 200 rounds of .50 cal ammunition in each exercise.

  Fixed wing gunnery exercises involve the flight of two aircraft that begin to descend to the target from an altitude of approximately 914 meters (m) (3,000 feet [ft]) while still several miles away. Within a distance of 1,219 m (4,000 ft) from the target, each aircraft fires a burst of approximately 30 rounds before reaching an altitude of 305 m (1,000 ft), then breaks off and repositions for another strafing run until each aircraft expends its exercise ordnance allowance of approximately 250 rounds. Typically these fixed wing exercise events involve an F/A-18 and AH-1 with Vulcan M61A1/A2, 20 mm cannon; AV-8 with GAU-12, 25 mm cannon.

- **Rocket Exercise:** Fixed- and rotary-wing aircraft crews launch rockets at surface maritime targets, day and night, with the goal of destroying or disabling enemy ships or boats. These operations employ 2.75-inch and 5-inch rockets.

1.2.3 Quantity and Accuracy of Ordnance Used

The proposed amounts of ordnance to be expended at BT-9 and BT-11 under the proposed action are 897,932 and 1,109,955, respectively (Table 1-3 and Table 1-4). The amounts of ordnance expended at the BTs account for all use of the targets, including Navy use. There are five types of explosive sources used at BT-9: 2.75” Rocket High Explosives, 5” Rocket High Explosives, 30 mm High Explosives, 40 mm High Explosives, and G911 grenades. No high explosive munitions are used at BT-11.

Table 1-3. Proposed Level of Live and Inert Munitions Expended at BT-9

Proposed Munitions	Proposed Total No. of Rounds	Proposed Number of Explosive Rounds Having an Impact on the Water	Net Explosive Weight (lb)
Small Arms Rounds Excluding .50 cal	525,610	N/A	N/A
.50 Cal	257,067	N/A	N/A
Large Arms Rounds – Live	12,592	30mm HE: 3,120 40mm HE: 9,472	0.1019 0.1199
Large Arms Rounds – Inert	93,024	N/A	N/A
Rockets – Live	241	2.75” Rocket: 184 5” Rocket: 57	4.8 15.0
Rockets – Inert	703	N/A	N/A
Bombs and Grenades – Live	144	G911 Grenade: 144	0.5
Bombs and Grenades – Inert	4,055	N/A	N/A
Pyrotechnics	4,496	N/A	N/A
Total	897,932	12,977	N/A

Note: Increased munitions estimated using FY 2007 Consolidated Utilization Range Report System (CURRS) data on a per sortie-operation basis. HE = High Explosive. All live rounds are not necessarily high explosive rounds. N/A = Not applicable.

Table 1-4. Proposed Level of Live and Inert Munitions Expended at BT-11

Proposed Munitions	Proposed Total No. of Rounds[1]
Small Arms Rounds Excluding .50 Cal	507,812
.50 Cal	326,234
Large Arms Rounds	240,334
Rockets	4,549
Bombs and Grenades	22,114
Pyrotechnics	8,912
Total	1,109,955

Note: 1. Increased munitions estimated using FY 2007 CURRS data on a per sortie-operation basis.

The main target areas used by MCAS Cherry Point are located in or relatively near to bodies of water resulting in the potential for rounds of munitions impacting or detonating in the water. BT-

9 comprises two hulls anchored in the water on the Brant Island Shoals. Because it is located and surrounded completely by water, DoN assumes that 100 percent of the munitions rounds expended at BT-9 would impact the water. The DoN also assumes that 100 percent of the munitions rounds expended at BT-9 would detonate in the water at a depth of approximately 1.2 m (3.9 ft).

BT-11 has three targets that are located either within or immediately adjacent to Rattan Bay. In addition, several other targets at BT-11 are located and used such that the associated Safety Danger Zones (SDZs) extend into the water. Thirty-six percent of the composite weapons SDZs fall over water. Based on the location of the SDZs, the DoN conservatively estimates that 36 percent of the total number of rounds expended at BT-11 would impact in the water.

1.3 SMALL BOAT MANEUVERS

A number of different types of boats are used depending on the unit using the boat and their mission. Boats are most often used by Naval Special Warfare teams, Navy Expeditionary Combat Command units (Naval Coastal Warfare, Inshore Boat Units, Mobile Security Detachments, Explosive Ordnance Disposal, and Riverine Forces), and US Coast Guard units. These units have missions to protect ships in harbors and high value units, such as aircraft carriers, nuclear submarines, liquid natural gas tankers, etc., while entering and leaving ports, as well as to conduct riverine operations, insertions and extractions, and various Naval Special Warfare operations. The boats used by these units include: Small Unit River Craft, Combat Rubber Raiding Craft, Rigid Hull Inflatable Boats, Patrol Craft, and many other versions of these types of boats. These boats use inboard or outboard, diesel or gasoline engines with either propeller or water jet propulsion.

Table 1-6 shows current surface-to-surface operations at BT-9 and BT-11. In FY 2007, a total of 216 boat sorties were conducted at BT-9 and BT-11. These sorties occurred in all seasons, with approximately the same number of sorties occurring in each season. The majority of boat sorties at BT-9 originated from MCB Camp Lejeune. Boats are transported on trailers from MCB Camp Lejeune to the Pamlico Sound for weapons training at BT-9, where live fire of 7.62 mm, .50 cal, and 40 mm grenades is allowed, as well as use of G911 concussion grenades.

Table 1-5. Current Boat Operations at BT-9 and BT-11

Range	Sorties[1]	Munitions Type	Munitions Expended[2]
BT-9	165	5.56 mm	1,468
		7.62 mm	218,500
		.50 cal	166,900
		40 mm Grenade - Inert	15,734
		40 mm Grenade – Live (HE)	9,472
		G911 Grenade	144
BT-11	51	7.62 mm	44,100
		.40 cal	4,600
		40 mm Grenade - Inert	1,517
		40 mm Illumination-Inert	9

Notes: 1. Sorties are from FY 2007 CURRS data.

2. Munitions expenditures for all munitions types except for the G911 grenade are from FY 2007 CURRS data. G911 grenades are not recorded as being used in FY 2007, so FY 2006 CURRS data were determined to be representative for this munitions type.

2. LOCATION OF THE ACTIVITIES

The BTs are located at the convergence of the Neuse River with Pamlico Sound (Figure 1-1). Pamlico Sound and its tributaries represent one of the largest intracoastal, estuarine ecosystems found in the United States (U.S.). Pamlico Sound is a shallow estuary with a mean water depth of 4.5 m (14.7 ft) and a low tidal range (approximately 10 centimeters [cm] [3.9 inches]) (Eisma et al. 1997; Paerl et al. 2001). The circulation in the sound is wind-driven and freshwater input, predominantly from the Neuse River, is low, resulting in long residence times for sound waters. Fine sand and silt cover the bottom of Pamlico Sound (Wells 1989; Eisma et al. 1997). Salinities in Pamlico Sound are highly variable, ranging from 10 to 31 practical salinity units (psu), and fluctuate seasonally with highest salinities found in the fall (15 to 31 psu) and lowest salinities found in spring (10 to 19 psu) (Wells 1989; National Ocean Service 2001). Surface water temperatures for Pamlico Sound vary seasonally with the average lowest temperatures (15 to 17 degrees Celsius [°C]) [59 to 62.6 degrees Fahrenheit [°F]) found in winter and the highest (26° to 27°C [78.8 to 80.6 °F]) occurring in summer (DoN 2003).

2.1 BOMBING TARGET-9

BT-9, also known as Brant Island Target (Figure 1-1), is a water-based target area located approximately 52 kilometers (km) (28 nautical miles [nm]) northeast of MCAS Cherry Point in Pamlico Sound, Pamlico County. It consists of a ship hull grounded on Brant Island Shoals. Brant Island Shoals is located approximately 4.8 km (3 miles [mi]) southeast of Goose Creek Island. Inert (non-explosive) ordnance (practice bombs) up to 454 kilograms (kg) (1,000 lbs) and live (explosive) ordnance up to 45.4 kg (100 lbs) TNT equivalent, including ordnance released during strafing, are authorized for use at this target range.

The target is defined by a 6 statute-mile (SM) diameter prohibited area designated by the U.S. Army Corps of Engineers, Wilmington District (33 CFR 334.420). Surface vessels are not permitted within the prohibited area, which is delineated by large signs located on pilings surrounding the perimeter of the BT.

Brant Island Shoal is oriented roughly northwest to southeast through the center of the circular target area. Hydrographic survey data collected for the vicinity of BT-9 indicate that water depths within the BT range from approximately 1.2 m along the crest of the shoal to 6 m at the perimeter of the prohibited area; bottom substrate exhibits a gradient ranging from harder-packed sediments (sand; possibly hard bottom) along the shoal crest in the shallowest water (1.2 to 3 m [4-10 ft]) to soft sediments (mud or silts) in the deeper regions off the flank of the shoal (depths greater than 4.9 m [16 ft]) (USMC 2001a). Surveys of the BT also indicate that areas of submerged debris appear to be clustered along the eastern half of the prohibited or target area (USMC 2001a).

Water temperatures at BT-9 average 8ºC (46.4 ºF) for winter (December through March), 18 ºC (64.4 ºF) for spring and fall (May and October, respectively), and 27ºC (80.6 ºF) for summer (June through September), while salinities remained a fairly constant 16.8 psu throughout the year (USMC 2001a).

2.2 BOMBING TARGET-11

BT-11 is a 50.6 square kilometers (sq km) (19.5 square miles [sq mi]) complex of land- and water-based targets on Piney Island. It includes both land (all of Piney Island) and surrounding water areas in the Pamlico Sound. The in-water stationary targets of BT-11 consist of a barge and PT boat located in roughly the center of Rattan Bay (Figure 2-1). All practice and live-fire exercises at MCAS Cherry Point ranges (BT-9 and BT-11) are conducted so that all ammunition and other ordnance strike and/or fall within the existing danger zones (water) (water prohibited areas) or water restricted areas for each of the bombing target ranges. A danger zone (water) is a defined water area that is closed to the public on an intermittent or full-time basis for use by military forces for hazardous operations such as target practice and ordnance firing. A water restricted area is a defined water area where public access is prohibited or limited in order to provide security for Government property and/or to protect the public from the risks of injury or damage that could occur from the Government's use of that area (33 CFR 334.2).

Surface danger zones are designated areas of rocket firing, target practice, or other hazardous operations (33 CFR 334.420). A surface danger zone is designated with a 2.9 km (1.8 sm) radius centered on a target in Rattan Bay. BT-11 also has three water restricted areas within 0.8 km (0.5 sm) radius areas located west of Point of Marsh and at Newstump Point and Jacks Bay. The prohibited area centered on the Rattan Bay target is closed to navigation at all times unless vessels are authorized by MCAS Cherry Point to enter the target area. The in-water target area (prohibited area) in Rattan Bay includes approximately 9.3 sq km (3.6 sq mi) of water surface. A currently proposed additional intermittent water restricted area would be designated around the already established danger zone (water) at BT-11 to better accommodate training in .50 cal weapons delivery fired from helicopters and boats.

Water depths in the center of Rattan Bay are estimated as 2.4 to 3 m (8 to 10 ft) with bottom depths ranging from 0.3 to 1.5 m (1 to 5 ft) adjacent to the shoreline of Piney Island (USMC 2001a). A shallow ledge, with substrate expected to be hard-packed to hard bottom, surrounds Piney Island.

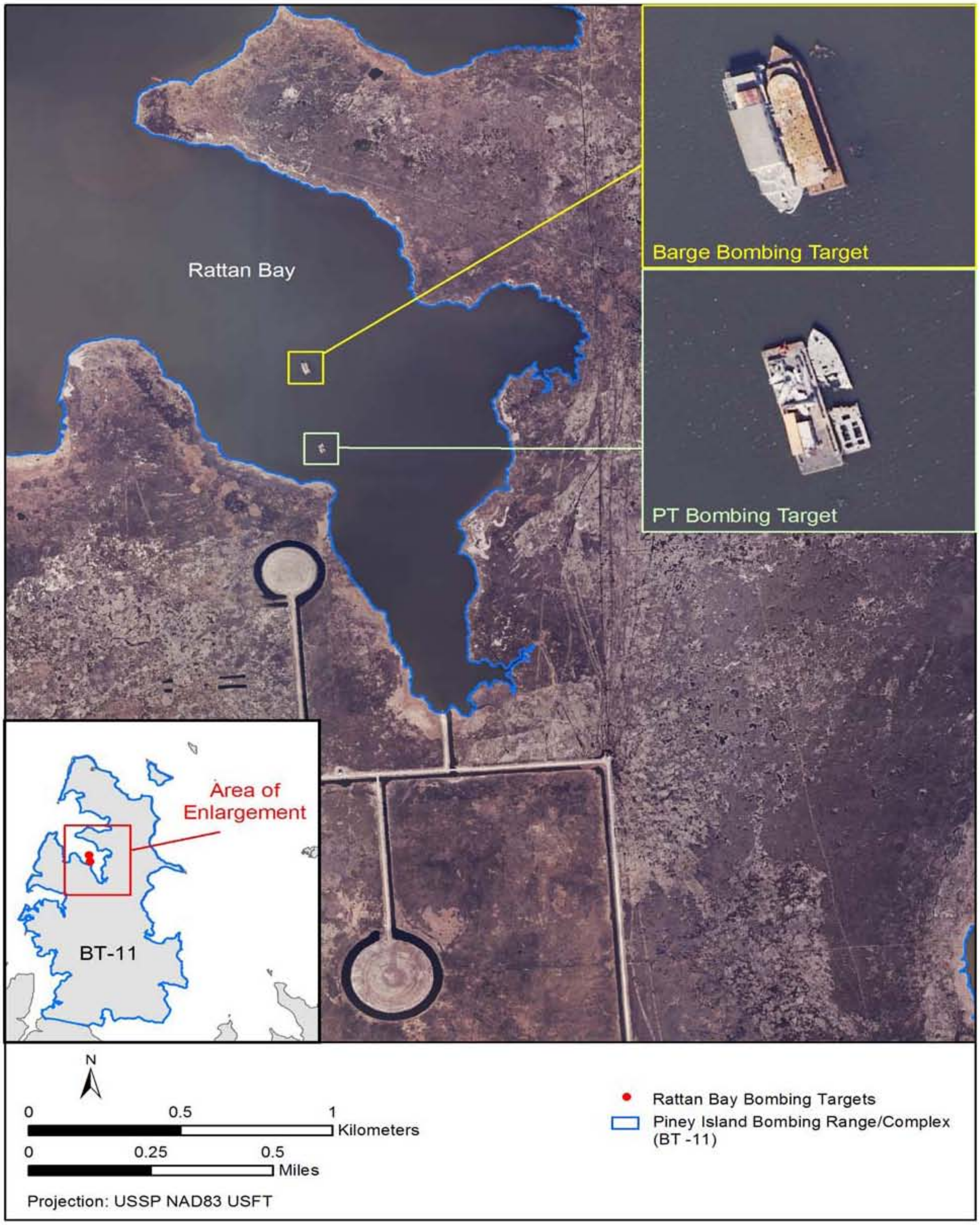

Figure 2-1. BTs at Rattan Bay, Piney Island Bombing Range/Complex (BT-11) (USMC 2001b; USMC 2004).

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3. AFFECTED SPECIES, STATUS, AND DISTRIBUTION

While there are records showing the occurrence of 40 marine mammal species in the nearshore and offshore waters of North Carolina, the vast majority of these species are oceanic in distribution. Only one marine mammal species, the common bottlenose dolphin (*Tursiops truncatus*), has been repeatedly sighted in Pamlico Sound, while an additional species, the endangered West Indian manatee (*Trichechus manatus*), has been sighted rarely (Lefebvre et al. 2001; DoN 2003). A review of the records contained in the North Atlantic Right Whale Database, maintained by the National Marine Fisheries Service (NMFS), shows that no sightings of the endangered North Atlantic right whale (*Eubalaena glacialis*) have ever been recorded within Pamlico Sound or in vicinity of the BTs (Kenney 2006). No suitable habitat exists for this species in the shallow Pamlico Sound or BT vicinity. Therefore, no further information regarding this species is included in this document.

Marine mammal distribution is affected by demographic, evolutionary, ecological, habitat-related, and anthropogenic factors (Bjørge 2002; Stevick et al. 2002). Marine mammal movements are often related to feeding or breeding activity (Stevick et al. 2002). Cetacean movements are often a reflection of the distribution and abundance of prey and changes in cetacean distributions have been correlated with shifts in the distribution and abundance of prey (Kenney et al. 1996). Marine mammal movements have also been linked to environmental parameters indirectly indicative of prey distribution such as temperature variations (oceanic fronts), sea-surface chlorophyll a concentrations, and bottom depth (Fiedler 2002).

In fulfillment of the MMPA, the NMFS has identified certain cetacean stocks as strategic. All marine mammal species listed under the Endangered Species Act (ESA) are strategic stocks. Marine mammal stocks are listed as strategic if non-natural mortalities or serious injuries (e.g., fishery takes) have either exceeded the predicted maximum the stock can withstand or insufficient information exists to make such a determination. Marine mammal stocks not listed under the ESA are listed as strategic under the same guidelines. When applicable to a stock, such information has been included with the species' description that follows.

3.1 BOMBING TARGET-11 MARINE MAMMAL SPECIES OF THE MCAS BOMBING TARGETS

Two marine mammal species, the common bottlenose dolphin and the West Indian manatee, occur with an expected or rare occurrence, respectively, in the vicinity of the BTs; all other species potentially occurring in the southwestern area of Pamlico Sound are considered extra-limital.

3.1.1 Common Bottlenose Dolphin *(Tursiops truncatus)*

Bottlenose dolphins are large and relatively robust, varying in color from light gray to charcoal. The genus *Tursiops* is named for its short, stocky snout that is distinct from the melon (Jefferson et al., 1993). The dorsal fin is tall, curved, and pointed. Striking regional variations exist in body size, with adult body lengths ranging from 1.9 to 3.8 m (6.2 to 12.5 ft) (Jefferson et al. 1993). *Tursiops* use a wide variety of feeding strategies and feed opportunistically on an assortment of fish, cephalopod, and shrimp species (Shane 1990; Wells and Scott 1999).

Scientists recognize two separate stocks of bottlenose dolphins in the western North Atlantic Ocean: nearshore (coastal) and offshore forms. The stocks can be distinguished by genetics, diet, blood characteristics, and outward appearance (Duffield et al., 1983; Hersh and Duffield, 1990; Mead and Potter, 1995; Curry and Smith, 1997). Within the nearshore stock, NMFS further segregates the stock into seven substocks or management units (MU) with discrete spatial and temporal components (Waring et al., 2008). Discrete MUs exhibit seasonal migrations regulated by temperature and prey availability (Torres et al., 2005; Waring et al., 2007), traveling as far north as New Jersey in summer and as far south as central Florida in winter (Waring et al., 2007). Two of the nearshore management units occur in the waters associated with Pamlico Sound, the Northern Migratory (NM) management unit and the Northern North Carolina (NNC) management unit. During the summer, the NM MU occurs from the New York/New Jersey border to the Virginia/North Carolina border. The NNC MU ranges from the Virginia/North Carolina border to Cape Lookout, North Carolina, during the summer months. In the winter months, these two MUs and a third, the Southern North Carolina (SNC) MU overlap along the coast of North Carolina and southern Virginia. A recent analysis suggests that a separate stock of bottlenose dolphins may exist in Pamlico Sound, NC. One suggestion is that there is a resident group of bottlenose dolphins in Pamlico Sound, which move into nearby nearshore waters in the winter; while an alternative suggestion is that this group is a subset of the migrating dolphins that overwinter in North Carolina waters (NMFS 2005a). Additional research is necessary to further delineate this North Carolina stock.

NMFS provides abundance estimates for each MU by season. During the summer, the best estimate of abundance for the NM and NNC MUs are 17,466 and 7,079 individuals respectively (Waring et al., 2008). During the winter, an estimated 16,913 individuals comprise the North Carolina Winter Mixed (NCWM) management unit, which is comprised of individuals from the NNC MU, the SNC MU, and the migratory MUs that overwinter in North Carolina coastal waters. The MUs making up the coastal stock are considered depleted under the MMPA (Waring et al., 2007).

Dive durations for Atlantic bottlenose dolphins lasting as long as 15 minutes are recorded for trained individuals (Ridgway et al., 1969). Typical dives, however, are more shallow and shorter in duration. Mean dive durations of Atlantic bottlenose dolphins typically range from 20 to 40 seconds at shallow depths (Mate et al., 1995) and can last longer than 5 minutes during deep offshore dives (Klatsky et al., 2005). Offshore bottlenose dolphins regularly dive to 450 m (1,476 ft) and possibly dive as deep as 700 m (2,297 ft) (Klatsky et al., 2005). Dive behavior of bottlenose dolphins may correlate with the 24-hour cycle of day and night, or diel cycle (Mate et al., 1995; Klatsky et al., 2005); this may be especially true for offshore stocks, which dive deeper and more frequently at night to feed on the deep scattering layer (Klatsky et al., 2005).

Sounds emitted by bottlenose dolphins have been classified into two broad categories: pulsed sounds (including clicks and burst-pulses) and narrow-band continuous sounds (whistles), which usually are frequency modulated. Clicks have a dominant frequency range of 110 to 130 kiloHertz (kHz) and a source level of 218 to 228 decibels referenced to 1 microPascal at 1 meter (dB re 1 μPa-m) peak-to-peak (Au, 1993) and 3.4 to 14.5 kHz and 125 to 173 dB re 1 μPam peak-to-peak, respectively (Ketten, 1998). Whistles are primarily associated with communication and can serve to identify specific individuals (i.e., signature whistles) (Caldwell and Caldwell, 1965; Janik et al., 2006). Up to 52 percent of whistles produced by bottlenose dolphin groups with mother-calf pairs can be classified as signature whistles (Cook et al., 2004). Sound

production is also influenced by group type (single or multiple individuals), habitat, and behavior (Nowacek, 2005). Bray calls (low-frequency vocalizations; majority of energy below 4 kHz), for example, are used when capturing fish, specifically sea trout (*Salmo trutta*) and Atlantic salmon (*Salmo salar*), in some regions (i.e., Moray Firth, Scotland) (Janik, 2000). Additionally, whistle production has been observed to increase while feeding (Acevedo-Gutiérrez and Stienessen, 2004; Cook et al., 2004). Furthermore, both whistles and clicks have been demonstrated to vary geographically in terms of overall vocal activity, group size, and specific context (e.g., feeding, milling, traveling, and socializing) (Jones and Sayigh, 2002; Zaretsky et al., 2005; Baron, 2006). For example, preliminary research indicates that characteristics of whistles from populations in the northern Gulf of Mexico significantly differ (i.e., in frequency and duration) from those in the western North Atlantic (Zaretsky et al., 2005; Baron, 2006).

Bottlenose dolphins can typically hear within a broad frequency range of 0.04 to 160 kHz (Au, 1993; Turl, 1993). Electrophysiological experiments suggest that the bottlenose dolphin brain has a dual analysis system: one specialized for ultrasonic clicks and another for lower-frequency sounds, such as whistles (Ridgway, 2000). Scientists have reported a range of highest sensitivity between 25 and 70 kHz, with peaks in sensitivity at 25 and 50 kHz (Nachtigall et al., 2000). Recent research on the same individuals indicates that auditory thresholds obtained by electrophysiological methods correlate well with those obtained in behavior studies, except at some lower (10 kHz) and higher (80 and 100 kHz) frequencies (Finneran and Houser, 2006).

Temporary threshold shifts (TTS) in hearing have been experimentally induced in captive bottlenose dolphins using a variety of noises (i.e., broad-band, pulses) (Ridgway et al., 1997; Schlundt et al., 2000; Nachtigall et al., 2003; Finneran et al., 2005; Mooney et al., 2005; Mooney, 2006). For example, TTS has been induced with exposure to a 3 kHz, one-second pulse with sound exposure level of 195 decibels referred to 1 micro-Pascal squared per second (dB re 1 μPa^2-s) (Finneran et al., 2005), one-second pulses from 3 to 20 kHz at 192 to 201 decibels referenced to 1 microPascal per meter (dB re 1μPa-m) (Schlundt et al., 2000), and octave band noise (4 to 11 kHz) for 50 minutes at 179 dB re 1 μPa-m (Nachtigall et al., 2003). Preliminary research indicates that TTS and recovery after noise exposure are frequency dependent and that an inverse relationship exists between exposure time and sound pressure level associated with exposure (Mooney et al., 2005; Mooney, 2006). Observed changes in behavior were induced with an exposure to a 75 kHz one-second pulse at 178 dB re 1 μPa-m (Ridgway et al., 1997; Schlundt et al., 2000). Finneran et al. (2005) concluded that a sound exposure level of 195 dB re 1 μPa^2-s is a reasonable threshold for the onset of TTS in bottlenose dolphins exposed to mid-frequency tones.

The overall range of the bottlenose dolphin is worldwide in tropical and temperate waters. This species occurs in all three major oceans and many seas. Dolphins of the genus *Tursiops* generally do not range poleward of 45º latitude, except around the United Kingdom and northern Europe (Jefferson et al., 1993). Climate changes can contribute to range extensions as witnessed in association with the 1982/83 El Niño event when the range of some bottlenose dolphins known to the San Diego, California area was extended 600 km (324 nm) northward to Monterey Bay (Wells et al., 1990). Bottlenose dolphins continue to occur in Monterey Bay to this day. In the western North Atlantic, bottlenose dolphins occur as far north as Nova Scotia but are most common in coastal waters from New England to Florida, the Gulf of Mexico, the Caribbean, and southward to Venezuela and Brazil (Würsig et al., 2000). Bottlenose dolphins occur seasonally in estuaries and coastal embayments as far north as Delaware Bay (Kenney, 1990) and in waters

over the outer continental shelf and inner slope, as far north as Georges Bank [Cetacean and Turtle Assessment Program (CETAP), 1982; Kenney, 1990].

Genetic analyses and spatial patterns observed from aerial surveys indicate regional and seasonal distribution differences between the coastal and offshore stocks. North of Cape Hatteras, the coastal stock is thought to be restricted to waters less than 25 m (82 ft) in depth, while offshore dolphins generally range beyond the 50-m (164-ft) isobath (CETAP, 1982; Kenney, 1990; Waring et al., 2007). Mitochondrial DNA and spatial analyses from dolphins south of Cape Hatteras suggest individuals sighted within 7.5 km (4 nm) of shore are of the coastal form and those beyond 34 km (18 nm) from shore and in waters with a bottom depth greater than 34 m (112 ft) are of the offshore form (Torres et al., 2003). However, Torres et al. (2003) also found an extensive region of overlap between the coastal and offshore stocks between 7.5 (4.0 nm) and 34 km (18 nm) from shore. Garrison et al. (2003b) also noted, that in this region, coastal dolphins may be found in waters as deep as 31 m (102 ft) and 75 km (40 nm) from shore while offshore dolphins may occur in waters as shallow as 13 m (43 ft). Additional aerial surveys and genetic sampling are required to better understand the distribution of the two stocks throughout the year.

Coastal bottlenose dolphins along the western Atlantic coast may exhibit either resident or migratory patterns (Waring et al., 2008). Photo-identification studies support evidence of year-round resident bottlenose dolphin populations in Beaufort and Wilmington, North Carolina (Koster et al., 2000; Waring et al., 2008); these are the northernmost documented sites of year-round residency for bottlenose dolphins in the western North Atlantic (Koster et al., 2000). A high rate of exchange occurs between the Beaufort and Wilmington sites as well (Waring et al., 2008). Individuals from the NM MU may enter these areas seasonally as well, as evidenced by a bottlenose dolphin tagged in 2001 in Virginia Beach who overwintered in waters between Cape Hatteras and Cape Lookout (NMFS- Southeast Fisheries Science Center [SEFSC], 2001).

Common bottlenose dolphins in North Carolina concentrate in shallow water habitats along shorelines, and few, if any, individuals are present in the central portions of the sounds (Gannon 2003; Read et al. 2003a, 2003b). Bottlenose dolphins in the BT area select shallow habitats, such as tributary creeks and the edges of the Neuse River, where the bottom depth is less than 3.5 m (Gannon 2003). Dolphins use the downstream portion of the Neuse River estuary and lateral creeks more than the upstream area (Gannon 2003). Dolphin density is highest during the spring (May and June) and lowest during the summer (July and August) in the Neuse River estuary (Gannon 2003). Fine-scale distribution of dolphins seems to relate to the presence of topography or vertical structure, such as the steeply-sloping bottom near the shore and oyster reefs, which may be used to facilitate prey capture (Gannon 2003).

Common bottlenose dolphins have been sighted during 11 boat-based surveys from 2002 through 2003 conducted for the USMC by Duke University in the waters surrounding BT-9 and BT-11; during this time, one sighting in the restricted area surrounding BT-9 and two sightings in proximity to BT-11 were observed, as well as seven sightings in adjacent waters for a total of 276 bottlenose dolphins sighted (Read et al. 2002, 2003b, 2003c). Some large groups of dolphins have been reported in the restricted BT areas. In October 2002, a sighting of 50 dolphins was made within BT-9 while two months later in December 2002, a group of 70 dolphins moved into the prohibited area of the in-water targets of BT-11 (Read et al. 2003b). The NMFS-Southeast Fisheries Science Center (SEFSC) in Beaufort, NC has aerially surveyed the area of

southwestern Pamlico Sound encompassed by the restricted airspace R-5306A, including both in-water BTs. From July 2004 through June 2005, the NMFS-SEFSC conducted 23 aerial surveys of the waters beneath the restricted airspace, during which time no dolphins were observed at or near BT-9 or BT-11, although a total of 296 common bottlenose dolphins were observed in the waters within the restricted airspace (Goodman et al. 2004, 2005a, 2005b, 2005c).

3.1.2 West Indian Manatee *(Trichechus manatus)*

The West Indian manatee is a rotund, slow-moving animal reaching a maximum length of 3.9 m (12.8 ft) (Jefferson et al. 1993). The manatee has a small head, a squarish snout containing two semi-circular nostrils at the front, and fleshy mobile lips. The tail is horizontal, rounded, and paddle-shaped. The body is gray or gray- brown and covered with fine hairs that are sparsely distributed. The back is often covered with distinctive scars resulting from collisions with boat propellers (Moore 1956).

West Indian manatees are classified as endangered under the ESA and afforded additional protection under the MMPA. West Indian manatee numbers are assessed by aerial surveys during the winter months when manatees are concentrated in warm-water refuges. Aerial surveys conducted in February 2006 by the Florida Marine Research Institute (FMRI) produced a preliminary abundance estimate of 3,113 individuals (FMRI, 2006). Along Florida's Gulf Coast, observers counted 1,474 West Indian manatees, while observers on the Atlantic coast counted 1,639. In the most recent revision of the West Indian manatee recovery plan, scientists concluded that, based on movement patterns, manatees around Florida should be divided into four relatively discrete management units or subpopulations. These subpopulations each represent a significant portion of the species' range (U.S. Fish and Wildlife Service [USFWS], 2001). West Indian manatees found along the Atlantic U.S. coast are of the Atlantic subpopulation (USFWS, 2001). The other three subpopulations in Florida are the Upper St. Johns River, Northwest and Southwest subpopulations (USFWS, 2001).

Manatees are shallow divers. The distribution of preferred seagrasses is mostly limited to areas of high light; therefore, manatees are fairly restricted to shallower nearshore waters (Lefebvre et al., 2001). It is unlikely that manatees descend much deeper than 20 m (66 ft), and manatees do not usually remain submerged for longer than 2 to 3 minutes. However, when resting on the bottom, manatees have been known to stay submerged for up to 24 minutes (Reynolds III, 1981).

West Indian manatees produce a variety of squeak-like sounds that have a typical frequency range of 0.6 to 12 kHz (dominant frequency range from 2 to 5 kHz), and last 0.25 to 0.5 s (Steel and Morris, 1982; Thomson and Richardson, 1995; Niezrecki et al., 2003). Recently, vocalizations below 0.1 kHz have also been recorded (Frisch and Frisch, 2003; Frisch, 2006). Overall, West Indian manatee vocalizations are considered relatively stereotypic, with little variation between isolated populations examined (i.e., Florida and Belize) (Nowacek et al., 2003). However, vocalizations have been shown to possess nonlinear dynamic characteristics (e.g., subharmonics or abrupt, unpredictable transitions between frequencies). These characteristics could aid in individual recognition and mother-calf communication (Mann et al., 2006). Average source levels for vocalizations have been calculated to range from 90 to 138 dB re: 1 μPa (average: 100 to 112 dB re: 1 μPa) (Nowacek et al., 2003; Phillips et al., 2004). Behavioral data on two animals indicate an underwater hearing range of approximately 0.4 to 46

kHz, with best sensitivity between 16 and 18 kHz (Gerstein et al., 1999), while earlier electrophysiological studies indicated best sensitivity from 1 to 1.5 kHz (Bullock et al., 1982).

West Indian manatees occur in warm, subtropical, and tropical waters of the western North Atlantic Ocean, from the southeastern U.S. to Central America, northern South America, and the West Indies (Lefebvre et al., 2001). West Indian manatees occur along both the Atlantic and Gulf coasts of Florida. West Indian manatees are sometimes reported in the Florida Keys; these sightings are typically in the upper Florida Keys, with some reports as far south as Key West (Moore, 1951a, 1951b; Beck, 2006a). During winter months, the West Indian manatee population confines itself to inshore and inner shelf waters of the southern half of peninsular Florida and to springs and warm water outfalls (e.g., power plant cooling water outfalls). As water temperatures rise in spring, West Indian manatees disperse from winter aggregation areas. West Indian manatees are frequently reported in coastal rivers of Georgia and South Carolina during warmer months (Lefebvre et al., 2001).

Historically, West Indian manatees were likely restricted to southernmost Florida during winter and expanded their distribution northward during summer. However, industrial development has made warm-water refuges available (e.g., power plant effluent plumes), and the introduction of several exotic aquatic plant species has expanded the available food supply. These factors have enabled an expansion of the manatee’s winter range (USFWS, 2001; Laist and Reynolds, 2005). Several patterns of seasonal movement are known along the Atlantic coast ranging from year-round residence to long-distance migration (Deutsch et al., 2003). Deutsch et al., (2003) found that manatees are highly consistent in seasonal movement patterns and show strong fidelity to warm and winter ranges, both within and across years.

Although West Indian manatees are expected to inhabit nearshore areas, a few individuals have been sighted offshore. West Indian manatees off the east coast of Florida have been documented to occasionally make their way further offshore. For example, “Xoshi” was radio-tagged and released near Biscayne Beach in March 1999. A few weeks later, she was “rescued” 60 km (32 nm) offshore of Port Canaveral, Florida in the Gulf Stream (Reid et al., 1991). Perhaps the most famous long-distance movements of any West Indian manatee were exhibited by the animal known as “Chessie,” who gained fame in the summer of 1995 by swimming to Rhode Island, returning to Florida for the winter, and traveling north again to Virginia where he was last seen in 1996 (U.S. Geological Survey, 2001). In early September 2001, “Chessie” was once again sighted in Virginia. More recently, in August 2006, a West Indian manatee was sighted in waters off Rhode Island and Massachusetts, as well as in the Hudson River in New York City (Anonymous, 2006; Beck, 2006b).

In general, manatee sightings along the Atlantic coast drop off markedly north of South Carolina (Lefebvre et al. 2001). Manatees were first sighted in North Carolina waters in 1919 and have been intermittently observed there since (Schwartz 1995). Most reported sightings in the inshore waters of North Carolina occur during the summer months but sightings have been reported from June through October (DoN 2003; North Carolina Natural Heritage Program 2004). In the vicinity of the BTs, manatees have not been observed during the last 20 years in the waters adjacent to Pamlico County but are known to occur in the waters of Carteret County (North Carolina Natural Heritage Program 2004). For example, on 13 August 2002, the BT-11 range operators sighted a manatee in the canal directly adjacent to the range complex.

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4. MARINE MAMMAL DENSITY ESTIMATES

All MCAS Cherry Point sites are within the shallow waters of Pamlico Sound (Figure 10-1). Within this area, the only marine mammal species that will occur regularly and for which reliable densities are available is the bottlenose dolphin (*Tursiops truncatus*). The West Indian manatee occurs so rarely in the vicinity of the BTs that no density estimate can be derived for this species in the waters of Pamlico Sound.

Aerial surveys specifically for dolphins and turtles were conducted in Pamlico and Core sounds from July 2004 to April 2006 (Goodman et al., 2007). Densities for bottlenose dolphins in the western part of Pamlico Sound (overlying the MCAS Cherry Point sites) ranged from 0.0272/km^2 (0.0105 mi^2) in winter to 0.2158/km^2 (0.0833 mi^2) in autumn (Goodman et al., 2007). The authors noted that animals were likely to be missed during the aerial surveys compared to boat-based surveys due to the short amount of time that observers have to make a sighting, resulting in underestimated densities. Goodman et al. (2007) were unable to incorporate correction factors for animals residing at the surface but not sighted in surveys, and animals not sighted because they were below the surface during surveys. A mark-recapture survey was conducted in the estuaries, bays and sounds of North Carolina by Read et al. (2003a) in summer 2000, which yielded a density of 0.183/ km^2 (0.071 mi^2) (based on an estimate of 919 dolphins for the northern inshore waters divided by an estimated 5,015 km^2 (1,936 mi^2) survey area, as measured in ArcGIS; Figure 5) for dolphins in North Carolina inland waters. Although this density is slightly lower than the highest density from Goodman et al. (2007), it is likely more precise and incorporates less bias than estimates derived from aerial surveys and is therefore a more conservative and applicable estimate. Surveys were done only in summer, but this population is considered resident and likely does not leave the estuary and sounds, therefore this density would apply to all MCAS Cherry Point sites year round.

Bottlenose dolphin densities for Pamlico Sound are listed in Table 10-1.

4.1 EXPOSURE MODELING CONSIDERATIONS

To increase the accuracy of modeling when estimating potential exposures of marine mammals from specific sources, a three-dimensional density estimate it utilized. Typically, density is reported for an area in the following form: animals/square kilometers (km^2). Analyses of survey results generally include correction factors for animals at the surface as well as animals that may be below the surface and not seen. Therefore, although the area (e.g., km^2) appears to represent only the surface of the water (two-dimensions), density actually implicitly includes animals anywhere within the water column under that surface area. By combining marine mammal densities with depth distribution information, a three-dimensional density estimate is achieved.

Generally, these density estimates assume that animals are uniformly distributed within the prescribed area, even though this may not be entirely accurate in nature. For instance, marine mammals are often clumped in areas of greater importance such as areas of high productivity, lower predation, safe calving, basking, etc. Density can occasionally be calculated for smaller areas that are used regularly by marine mammals, but more often than not, there is insufficient data to calculate density for small areas. Tagging and other technologies have also expanded our

understanding of marine mammal behavior and the physiological parameters which drive the ways marine mammals utilize the water column. For instance, some species are capable of regular deep dives (>800 meters [m] [2,625 ft]), while others dive to <200 m (656 ft) or shallower, regardless of the bottom depth. There is limited depth distribution data for most marine mammals, especially cetaceans. This is a result of the difficulties associated with tracking cetaceans, which must be tagged at-sea using a tag that is either implanted into the skin/blubber or adheres to the skin. While some suitable depth distribution data exist for some marine mammal species, sample sizes are usually extremely small (nearly always fewer than 10 animals, and most often only one or two). Often, depth distribution information is interpolated from similar species for which more data exist or from other indirect methodologies, such as stomach content analysis, habitat preference analysis, or preferred prey characteristics. However, due to the complexities of animal behavior and the limited availability of fine-scale information, when assuming an even distribution, modeling remains the standard for describing animal densities. While assuming this may not be the most accurate depiction, and can present a distorted view of marine mammal distribution in a region, it remains the best available science.

For the marine mammal species present in the MCAS Cherry Point sites (i.e., the bottlenose dolphin) sufficient data exist to describe depth information more accurately than assuming an even distribution. In the modeling, all bottlenose dolphins within the Cherry Point site areas were distributed in waters with less than 10 m (33 ft) of depth.

4.2 IMPACTS FROM EXPLOSIVE MUNITIONS FIRING: UNDERWATER NOISE

4.2.1 Regulatory Framework

All marine mammals are protected under the MMPA. The MMPA prohibits, with certain exceptions, the take of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the United States. The Endangered Species Act of 1973 (ESA) provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and the conservation of their ecosystems. A “species” is considered endangered if it is in danger of extinction throughout all or a significant portion of its range. A species is considered threatened if it is likely to become an endangered species within the foreseeable future. There are marine mammals, already protected under MMPA, listed as either endangered or threatened under ESA, and afforded special protections.

Actions involving sound in the water include the potential to harass marine animals in the surrounding waters. Demonstration of compliance with MMPA and the ESA, using best available science, has been assessed using criteria and thresholds accepted or negotiated, and described here.

Sections of the MMPA (16 U.S.C. 1361 et seq.) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity, other than commercial fishing, within a specified geographical region. Through a specific process, if certain findings are made and regulations are issued or, if the taking is limited to harassment, notice of a proposed authorization is provided to the public for review.

Authorization for incidental takings may be granted if NMFS finds that the taking will have no more than a negligible impact on the species or stock(s), will not have an immitigable adverse impact on the availability of the species or stock(s) for subsistence uses, and that the permissible methods of taking, and requirements pertaining to the mitigation, monitoring and reporting of such taking are set forth. NMFS has defined negligible impact in 50 CFR 216.103 as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to adversely affect the species or stock through effects on annual rates of recruitment or survival.

Subsection 101(a)(5)(D) of the MMPA established an expedited process by which citizens of the United States can apply for an authorization to incidentally take small numbers of marine mammals by harassment. The National Defense Authorization Act of 2004 (Public Law 108-136) removed the small numbers limitation and amended the definition of "harassment" as it applies to a military readiness activity to read as follows:

> *(i) any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or*
> *(ii) any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B Harassment].*

The primary potential impact to marine mammals from underwater acoustics is Level B harassment from noise.

4.2.2 Explosive Sources

The acoustic sources employed in the MCAS Cherry Point Exercise Areas are categorized as broadband (producing sound over a wide frequency band) explosives. Broadband explosives produce significant acoustic energy across several frequency decades of bandwidth. Propagation loss is sufficiently sensitive to frequency as to require model estimates at several frequencies over such a wide band.

Explosives are impulsive sources that produce a shock wave that dictates additional pressure-related metrics (peak pressure and positive impulse). Detailed descriptions of the sources in the MCAS Cherry Point Exercise Areas are provided in this subsection.

Explosives detonated underwater introduce loud, impulsive, broadband sounds into the marine environment. Three source parameters influence the effect of an explosive: the weight of the explosive material, the type of explosive material, and the detonation depth. The net explosive weight (or NEW) accounts for the first two parameters. The NEW of an explosive is the weight of TNT required to produce an equivalent explosive power.

The detonation depth of an explosive is particularly important due to a propagation effect known as surface-image interference. For sources located near the sea surface, a distinct interference pattern arises from the coherent sum of the two paths that differ only by a single reflection from the pressure-release surface. As the source depth and/or the source frequency decreases, these two paths increasingly, destructively interfere with each other, reaching total cancellation at the

surface (barring surface-reflection scattering loss). For MCAS Cherry Point there are five types of explosive sources: 2.75” Rocket High Explosives, 5” Rocket High Explosives, 30 mm High Explosives, 40 mm High Explosives, and G911 grenades.

The harassments expected to result from these sources are computed on a per in-water explosive basis; to estimate the number of harassments for multiple explosives, consider the following. Let A represent the impact area (that is, the area in which the chosen metric exceeds the threshold) for a single explosive. The cumulative effect of a series of explosives is then dictated by the spacing of the explosives relative to the movement of the marine wildlife. If the detonations are spaced widely in time or space, allowing for sufficient animal movements as to ensure a different population of animals is considered for each detonation, then the cumulative impact area of N explosives is merely NA regardless of the metric. This leads to a worst case estimate of harassments and is the method used in this analysis.

At the other extreme is the case where the detonations occur at essentially the same time and location (but not close enough to require the source emissions to be coherently summed). In this case, the pressure metrics (peak pressure and positive impulse) are constant regardless of the number of pings, while the energy metrics increase at a rate of $N^{½}$ (under spherical spreading loss only) or less.

The firing sequence for some of the munitions consists of a number of rapid bursts, often lasting a second or less. Due to the tight spacing in time, each burst can be treated as a single detonation. For the energy metrics the impact area of a burst is computed using a source energy spectrum that is the source spectrum for a single detonation scaled by the number of rounds in a burst. For the pressure metrics, the impact area for a burst is the same as the impact area of a single round. For all metrics, the cumulative impact area of an event consisting of N bursts is merely the product of the impact area of a single burst and the number of bursts, as would be the case if the bursts are sufficiently spaced in time or location as to insure that each burst is affecting a different set of marine wildlife.

All explosives are modeled as detonating at a 1.2 m (3.9 ft) depth. The NEW for these sources are provided in Table 4–1. Included in this table are the peak one-third-octave (OTO) source level and the approximate frequency at which the peak occurs.

Table 4-1. Source Weights and Peak Source Levels

Source Type	NEW	Peak OTO SL	Frequency of Peak OTO SL	Rounds per Burst
2.75” Rocket	4.8 lbs	223.9 dB re: 1µPa	~ 1500 Hertz (Hz)	1
5” Rocket	15.0 lbs	228.9 dB re: 1µPa	~ 1000 Hz	1
30 mm	0.1019 lbs	212.1 dB re: 1µPa	~ 2500 Hz	30
40 mm	0.1199 lbs	227.8 dB re: 1µPa	~ 1100 Hz	5
G911 Grenade	0.5	213.9 dB re: 1 µPa	~ 2500 Hz	1

For sources that are detonated at shallow depths, it is frequently the case that the explosion may breech the surface with some of the acoustic energy escaping the water column. The source levels presented in the table above have not been adjusted for possible venting nor does the subsequent analysis attempt to take this into account. Because of the low source net explosive weights and sufficient depths (1.2 m [3.9 ft]) venting of noise energy through the surface is expected to be minor.

4.2.3 Criteria and Impact Thresholds for Underwater Noise on Marine Mammals

Criteria and Thresholds for Small Explosives

Criteria and thresholds for estimating the exposures from a single explosive activity on marine mammals were established for the Seawolf Submarine Shock Test Final Environmental Impact Statement (FEIS) ("Seawolf") and subsequently used in the USS *Winston S. Churchill* (DDG-81) Ship Shock FEIS ("Churchill") (DoN, 1998 and 2001). Due to the spatial and temporal characteristics, these detonations are treated as individual explosions with non-overlapping sound fields for the purpose of this analysis. NMFS adopted these criteria and thresholds in its final rule on unintentional taking of marine animals occurring incidental to the shock testing (National Oceanic and Atmospheric Administration [NOAA], 1998). In addition, this section reflects a revised acoustic criterion for small underwater explosions (i.e., 23 pounds per square inch [psi] instead of previous acoustic criteria of 12 psi for peak pressure over all exposures), which is based on an incidental harassment authorization (IHA) issued to the U.S. Air Force (NOAA, 2006a). Criteria and thresholds are summarized in Table 4-2.

Criteria and Thresholds for Injurious Physiological Effects

Single Explosions

The approach to risk assessment for impulsive sound in the water was derived from the Seawolf/Churchill approach. For injury, MCAS Cherry Point uses dual criteria: eardrum rupture (i.e. tympanic membrane [TM] rupture) and onset of slight lung injury. These criteria are considered indicative of the onset of injury. The threshold for TM rupture corresponds to a 50 percent rate of rupture (i.e., 50 percent of animals exposed to the level are expected to suffer TM rupture); this is stated in terms of an Energy Flux Density (EFD) Level value of 1.17 inch pounds per square inch (in-lb/in2) (about 205 dB re 1 μPa^2-s). This recognizes that TM rupture is not necessarily a serious or life-threatening injury, but it is a useful index of possible injury that is well correlated with measures of permanent hearing impairment [e.g., Ketten (1998) indicates a 30 percent incidence of permanent threshold shift (PTS) at the same threshold].

The threshold for onset of slight lung injury is calculated for a small animal (a dolphin calf weighing 29.6 lbs) and is given in terms of the "Goertner modified positive impulse," indexed to 13 psi-millisecond (msec) (DoN, 2001). This threshold is conservative since the positive impulse needed to cause injury is proportional to animal mass, and therefore, larger animals require a higher impulse to cause the onset of injury. This analysis assumed the marine species populations were 100 percent small animals. The criterion with the largest potential impact range (most conservative), either TM rupture (energy threshold) or onset of slight lung injury (peak pressure threshold), will be used in the analysis to determine injurious physiological exposures.

For mortality, MCAS Cherry Point uses the criterion corresponding to the onset of extensive lung injury. For small mammals, the threshold is given in terms of the Goertner modified positive impulse, indexed to 30.5 pounds per square inch-millisecond (psi-ms). Since the Goertner approach depends on propagation, source/animal depths, and animal mass in a complex way, the actual impulse value corresponding to the 30.5 psi-msec index is a complicated calculation. To be conservative, the analysis used the mass of a dolphin calf (at 12.2 kg [26.9 lbs]) for 100 percent of the populations. This analysis was also conservative in that it corresponds to a 1 percent chance of mortal injury, and yet any animal experiencing onset severe lung injury is counted as a lethal exposure.

Multiple Explosions

For multiple successive explosions, the acoustic criteria were developed from an extension of the Churchill approach. For multiple explosions, accumulated energy over the entire training time is the natural extension for energy thresholds since energy accumulates with each subsequent shot (explosion); this is consistent with the treatment of multiple arrivals in Churchill. For positive impulse, it is consistent with Churchill to use the maximum value over all impulses received.

Criteria and Thresholds for Non-injurious Physiological Effects

The MCAS Cherry Point criterion for non-injurious physiological effects is temporary threshold shift (TTS) – a slight, recoverable loss of hearing sensitivity (DoN, 2001). For this assessment, there are dual thresholds for TTS, an energy threshold and a peak pressure threshold. The criterion with the largest potential impact range (most conservative) either the energy threshold, or peak pressure threshold, will be used in the analysis to determine non-injurious physiological (TTS) exposures.

Single Explosion – TTS Energy Threshold

The TTS energy threshold is a 182 dB re 1 μPa^2-s maximum energy flux density level in any 1/3-octave band at frequencies above 100 Hz for toothed whales and in any 1/3-octave band above 10 Hz for baleen whales. For large explosives, the latter limits at 100 and 10 Hz make a difference in the impact range estimates. NMFS has defined large explosives in prior rulemaking as greater than 907 kg (2,000 lbs) Net Explosive Weight (NEW) (NMFS, 2006b). For small explosives (<1500 lbs NEW), as what was modeled for this analysis, the spectrum of the shot arrival is broad, and there is essentially no difference in exposure ranges resulting from the 10 and 100 Hz frequency range cutoffs for the two classes of whales.

The TTS energy threshold for explosives is derived from the Space and Naval Warfare Systems Center pure-tone tests for TTS (Schlundt et al., 2000; Finneran and Schlundt, 2004). The pure-tone threshold (192 decibels (dB) as the lowest value) is modified for explosive by (a) interpreting it as an energy metric, (b) reducing it by 10 dB to account for the time constant of the mammal ear, and (c) measuring the energy in 1/3 octave bands, the natural filter band of the ear. The resulting threshold is 182 dB re 1 μPa^2-s in any 1/3 octave band. The energy threshold usually dominates over peak pressure threshold and is used in the analysis to determine potential non-injurious physiological (TTS) for single explosion ordnance.

Single Explosion - TTS Peak Pressure Threshold

The TTS peak pressure threshold applies to all cetacean species and is stated in terms of peak pressure at 23 psi (NOAA, 2006b). This threshold was adopted for Precision Strike Weapons (PSW) Testing and Training by Eglin Air Force Base in the Gulf of Mexico (NMFS, 2005). It is important to note that for small shots near the surface (such as in this analysis), the 23-psi peak pressure threshold will generally produce longer exposure ranges than the 182-dB energy metric. Furthermore, it is not unusual for the TTS exposure range for the 23-psi pressure metric to actually exceed the disturbance exposure range for the 177-dB energy metric.

Multiple Explosions – TTS

For multiple explosions, accumulated energy over the entire training time is the natural extension for energy thresholds since energy accumulates with each subsequent shot/detonation. This is consistent with the energy argument in Churchill. For peak pressure, it is consistent with Churchill to use the maximum value over all impulses received.

Criteria and Thresholds for Behavioral Effects

Single Explosion

For a single explosion, to be consistent with Churchill, TTS is the criterion for non-injurious physiological exposure. In other words, because behavioral disturbance for a single explosion is likely to be limited to a short-lived startle reaction, use of the TTS criterion is considered sufficient protection and, therefore, behavioral effects are not considered for single explosions.

Multiple Explosions – without TTS

For this analysis, because multiple explosions would occur within a discrete time period, a new acoustic criterion – behavioral disturbance – is used to account for behavioral effects significant enough to be judged as harassment, but occurring at lower noise levels than those that may cause TTS.

The threshold is based on test results published in Schlundt et al. (2000), with derivation following the approach of the Churchill EIS for the energy-based TTS threshold. The original Schlundt et al. (2000) data and the report of Finneran and Schlundt (2004) are the basis for thresholds for behavioral disturbance. As reported by Schlundt et al. (2000), instances of altered behavior generally began at lower exposures than those causing TTS; however, there were many instances when subjects exhibited no altered behavior at levels above the onset-TTS levels. Regardless of reactions at higher or lower levels, all instances of altered behavior were included in the statistical summary.

The behavioral disturbance threshold for tones is derived from the SSC tests, and is found to be five dB below the threshold for TTS, or 177 dB re 1 μPa^2-s maximum energy flux density level in any 1/3 octave band at frequencies above 100 Hz for toothed whales, and in any 1/3 octave band above 10 Hz for baleen whales. As stated previously for TTS, for small explosives (< 1m,500 lbs NEW), as what was modeled for this analysis, the spectrum of the shot arrival is broad and there is essentially no difference in exposure ranges for toothed or baleen whales. In shallower water, the behavioral disturbance exposure range can be about twice the exposure

range for TTS. However, in deeper water, the TTS exposure criteria (23 psi) exposure range can result in a longer exposure range than the behavioral disturbance criteria. This is due to the fact that in a deeper water environment, it is more likely that there is a direct path for the shockwave to propagate, which results in a larger peak pressure range. In shallow water, there is reflection, absorption, and cancellation of the shockwave propagation due to interactions with the seafloor, which can limit the peak pressure range.

Summary of Thresholds and Criteria for Impulsive Sounds

Table 4-2 summarizes the effects, criteria, and thresholds used in the assessment for impulsive sounds. Non-injurious effects are determined by either the dual physiological criteria for single detonations, or by the behavioral criteria for multiple detonations. The criterion for behavioral disturbance used in this analysis is based on the use of multiple explosives.

Table 4-2. Effects, Criteria, and Thresholds for Impacts to Marine Mammals from Small Explosives

Effect	Criteria	Metric	Threshold	MMPA Harassment Level
Onset Mortality	Onset extensive lung injury	Goertner modified positive impulse	30.5 psi-ms	Mortality
Injurious Physiological	50 percent TM rupture	Energy flux density	205 dB re 1μ Pa^2-s (1.17 in-lb/in2)	Level A
Injurious Physiological	Onset slight lung injury	Goertner modified positive impulse	Indexed to 13 psi-ms	Level A
Non-injurious Physiological	TTS (for single explosions)	Greatest energy flux density level in any 1/3-octave band for total energy over all exposures	182dB re 1μ Pa^2-s	Level B
Non-injurious Physiological	TTS (for multiple successive explosions)	Peak pressure over all exposures	23 psi	Level B
Non-injurious Behavioral	Behavioral Disturbance	Greatest energy flux density level in any 1/3 octave band for total energy over all exposures (multiple explosions only)	177 dB re 1μ Pa^2-s	Level B

dB re 1μ Pa^2-s = decibel referenced to 1 micropascal squared second; Hz = hertz; psi-ms = pounds per square inch-millisecond; TM = tympanic membrane; TTS = temporary threshold shift

4.3 UNDERWATER NOISE IMPACTS FROM EXPLOSIVE ORDNANCE

Table 4-3 lists the range in meters of the explosive effects associated with a particular threshold. Table 4- presents the number of bottlenose dolphins potentially affected by underwater noise using the methodology described previously in this section. An estimate of the number of animals exposed to noise above established thresholds from a given type of detonation (exposure) was calculated by first multiplying the area of noise associated with a particular effect or harassment threshold by the annual density of bottlenose dolphins for Pamlico Sound. As previously discussed the area exposed to explosive noise is affected by such factors as amount of net explosive weight, depth of explosion and environmental province. The volume of the area exposed to the sound relative to each threshold level was multiplied by the dolphin density and

Table 4-3. Explosive Noise Maximum Effect Ranges for Impact Thresholds

	Behavioral Disturbance (177 dB Energy)	TTS (23 psi)	Level A (13 psi-msec)	Mortality (31 psi-ms)
2.75" Rocket HE	N/A	172 m (564 ft)	47 m (154 ft)	27 m (89 ft)
5" Rocket HE	N/A	255 m (837 ft)	61 m (200 ft)	39 m (128 ft)
30mm HE	209 m (686 ft)	N/A	10 m (33 ft)	5 m (16 ft)
40mm HE	144 m (472 ft)	N/A	10 m (33 ft)	5 m (16 ft)
G911 Grenade	N/A	83 m (272 ft)	21 m (33 ft)	10 m (33 ft0

Table 4-4. Potential Bottlenose Dolphin Exposures to Underwater Noise

	Behavioral Disturbance	TTS	Level A	Mortality
2.75" Rocket HE	N/A	4.97	0.17	0.06
5" Rocket HE	N/A	3.39	0.09	0.03
30mm HE	2.55	N/A	0.05	0.00
40mm HE	12.60	N/A	0.16	0.01
G911 Grenade	N/A	0.87	0.03	0.01
Total	**15.15**	**9.23**	**0.5**	**0.11**

N/A = The criteria are not applicable.

4.4 ESTIMATING IMPACTS OF INERT ORDNANCE

The potential risk to marine mammals from non-explosive ordnance without any conservation measures entails two possible impacts, from noise or from the ordnance physically hitting an animal. Estimates of the noise fields generated in water by the impact of non-explosive ordnance indicate that the energy radiated is about 1 to 2 percent of the total kinetic energy of the impact. This energy level (and likely peak pressure levels) is well below the impact threshold, even at 1-m from the impact. Therefore, the noise generated by the in-water impact of non-explosive ordnance will not pose a risk to marine life; the only potential risk to marine mammals from non-explosive ordnance is from the very small possibility that the ordnance will hit (strike) an animal.

The potential risk of a direct hit to an animal in the target area is estimated to be so low it is discountable. A Range Air Installation Compatible Use Zone (RAICUZ) study generated the surface area or footprints of weapon impact areas associated with air-to-ground ordnance delivery (USMC 2001a). Statistically, a weapon safety footprint describes the area needed to contain 99.99 percent of initial and ricochet impacts at the 95 percent confidence interval for each type of aircraft and ordnance utilized on the BTs. At both BT-9 and BT-11 the probability of deployed ordnance landing in the impact footprint is essentially 1.0, since the footprints were designed to contain 99.99 percent of impacts, including ricochets. However, only 36 percent of the weapon footprint for BT-11 is over water in Rattan Bay, so the likelihood of a weapon striking an animal at the BT in Rattan Bay is 64 percent less. Water depths in Rattan Bay range from 3 m (10 ft) in the deepest part of the bay to 0.5 m (1.6 m) close to shore, so that nearly the entire habitat in Rattan Bay suitable for marine mammal use (or 36 percent of the weapon footprint).

The probability of hitting a bottlenose dolphin at the BTs can be derived by:

Probability = dolphin's dorsal surface area * density of dolphins

Example: Probability for BT-9 = 1.425 m^2 * 0.183 km^2 = 2.61 x 10^{-7}

The estimate of the dorsal surface area of a bottlenose dolphin is assumed to be 1.425 m^2 (or the average length of 2.85 m times the average body width of 0.5 m). Thus, using Read et al.'s (2003d) density estimates (0.183 km^2), the probability of a dolphin being hit in the waters of BT-9 is 2.61 x 10^{-7} and of BT-11 is 9.4 x10^{-8} (or 36 percent of the BT-11 probability of 2.61 x 10^{-7}). Using the proposed levels of ordnance expenditures at each in-water BT (Tables 1-3 and 1-4) and taking into account that only 36 percent of the ordnance deployed at BT-11 is over water, the estimated potential number of ordnance strikes on a marine mammal per year is estimated as 0.263 at BT-9 and 0.034 at BT-11 (Table 4-3). It would take approximately three years of ordnance deployment at the BTs before it would be likely or probable that one bottlenose dolphin would be struck by deployed inert ordnance.

Table 4-3. Estimated number of potential direct strikes on cetaceans from inert ordnance at the BTs expected annually.

	Estimated Ordnance Levels using FY 2007 data at BT-9 and in-water BT-11	Probability of Striking Dolphin/Ordnance Deployment	Number Ordnance Strikes/Year
BT-9	1,007,931	2.61 x 10^{-7}	0.263
BT-11	359,985	9.4 x 10^{-8}	0.034

4.5 IMPACTS FROM SMALL BOAT MANEUVERS

The bottlenose dolphin is the most common marine mammal species within the CHPT study area. Small boats operating at high speeds have the potential to strike a bottlenose dolphin, though Wells and Scott (1997) note that in the busy boating waters of Sarasota Bay, Florida, bottlenose dolphins suffer few injuries from boat traffic. Still, boat and dolphin collisions can occur. Wells and Scott (1997) have documented a few injuries and note that mothers with calves, and unhealthy dolphins may be particularly susceptible as they are limited in their movements. Wells and Scott (1997) noted obvious propeller-caused injuries to dolphins in

Sarasota Bay during periods of high recreational boat usage and coinciding with high speed powerboat races, though they did not correlate boat races nor a particular boat speed with dolphin strikes.

Small military boats operating within the CHPT water ranges may travel at speeds up to 74 km/hr (40 knots). However, the bottlenose dolphin is least susceptible to serious impacts from vessels because of its swimming speed and ability to maneuver around moving vessels.

In addition to direct strike, the presence of boats can result in disturbance, causing dolphins to alter their swimming patterns and behavior. Impacts such as disturbance are difficult to assess given the affinity this species has to bowride in front of moving vessels. Some researchers have noted changes in behavior of bottlenose dolphins to vessels as far away as 100 meters (328 ft). These alterations include changes in direction, changes in breathing rate and decreased spacing between dolphins traveling in the same group (Lemon et al., 2006).

The West Indian manatee is susceptible to injury because it is slow moving, and when surfacing to breathe, may be struck by boats and propellers. Because this species rarely occurs within the study area, the likelihood of an encounter with a small boat is very low.

4.6 INDIRECT IMPACTS

Explosive ordnance may have an impact not only on marine mammals but also on other species and the ecosystem of BT-9. Explosive and non-explosive ordnance delivery can also impact the bottom sediments at both BTs as can the routine target replacement or equipment/system maintenance. Sediment disturbance effects from ordnance delivery are difficult to predict but are expected to be initially disturbed after ordnance delivery with quick settlement afterwards. Thus the turbidity impacts on marine biota in the vicinity of the BTs are expected to be of short duration and negligible.

The distributions of various fishes and invertebrates in the vicinity of BT-9 may be impacted by explosive ordnance but the ecosystem impact is expected to be of a brief duration and result primarily in fish evacuating the vicinity of the blast. Since little time is expected to occur before fish or invertebrates move back into the detonation area, no adverse effect is expected on the trophic regime or ecosystem at BT-9. The likelihood of any permanent ecosystem impact at BT-11 due to inert ordnance use is also extremely unlikely.

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5. IMPACTS ON SUBSISTENCE USE

Subsistence use pertains to the use of those species sought in traditional Arctic hunting areas. None of the marine mammal species discussed in this document is sought for subsistence use in the U.S. There would be no impacts on the availability of the species or stocks for subsistence use as identified in MMPA Section 101(a)(5)(A)(i).

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6. IMPACTS TO MARINE MAMMAL HABITAT AND RESTORATION

Potential impacts to marine mammal habitat at the BTs have previously been evaluated during a Section 7 consultation with the NMFS (USMC 2001a) and were determined to be minimal (NMFS 2002). Delivery of explosive or non-explosive ordnance may involve a temporary disturbance to the substrate (sediments) and a subsequent increase in localized turbidity. Turbidity may fluctuate based upon rainfall, wind, tides, and season. It is difficult to predict the amount of disturbance that occurs immediately after ordnance hits the substrate. The amount of sediment disturbance will be influenced by whether or not the ordnance hits the target first before hitting the substrate as well as the orientation of the ordnance (i.e., whether it lands upright or on its side) upon impact with the sediments (USMC 2001a). Sediments in the action area are primarily soft sediments such as sand and mud, which should experience only minimal disturbance and quick resettlement. Impacts to the substrate are considered temporary and negligible with no adverse or long-term effects anticipated. Studies at the BTs of water quality following ordnance deployment have shown that turbidity levels are well below the state's water quality levels (USMC 2001a). Turbidity impacts are not likely to disturb the feeding or transiting behavior of dolphins in the vicinity of the BTs since this species does not rely on vision for maneuvering.

Physical effects associated with pressure waves generated by underwater detonations of explosives might affect fishes within proximity of BT-9. In particular, the rapid oscillation between high and low-pressure peaks has the potential to burst the swim bladders and other gas-containing organs of fishes (Keevin and Hempen 1997). Sublethal effects, such as changes in behavior of fishes, have been observed on several occasions as a result of noise produced by explosives (Wright 1982; National Resource Council 2003). The abundances of various fishes and invertebrates near the detonation point could be altered for a few hours before repopulation occurs. As a result, a short-term and localized effect on prey availability may be expected in the vicinity of BT-9.

Chemical effects of using explosive ordnance during training are considered negligible here as they were during the shock trial of the Winston S. Churchill (DoN 2001). Initial concentrations of the chemical by-products of ordnance detonations are not hazardous to marine life (O'Keeffe and Young 1984; DoN 2001). Water quality parameters at BT-9 and BT-11 are all within the limits set by North Carolina Water Quality Standards for Saltwater Classifications (for those parameters with Standards). Elevated aluminum concentrations or visual detections of chaff in either the water or sediment samples from any of the tested areas have not been detected with previous exercises (USMC 2001a).

While debris associated with ordnance delivery occurs at the BTs (e.g., parachutes, strands of chaff and ordnance remains), no reports of ingestion of debris has been reported nor have any stranded animals been reported with such contents in their stomachs (USMC 2001a). It is most likely that ordnance debris will sink to the bottom and become incorporated into the sediments and is thus not likely to be ingested by marine mammals.

Target establishment and maintenance occurs infrequently (i.e., every five years), and MCAS personnel are required to ensure that new targets are free of environmental contaminants prior to placing them in the water for use. Small boat operations or target replacement could also occasionally result in temporary and infrequent sediment disturbance, as explained above with explosive impacts to sediments.

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7. MEANS OF EFFECTING THE LEAST PRACTICABLE ADVERSE IMPACTS

The MCAS incorporates specific procedures in their operations to minimize adverse effects to protected species (USMC 2001a; NMFS 2002). Protective measures will be implemented to ensure the least practicable adverse impacts to marine mammals, primarily common bottlenose dolphins. Based on protective measures listed below, potential impacts would be minimized.

- Common bottlenose dolphins in Pamlico Sound, including BT-9 and the BT-11 complex, prefer habitats close to shore and have most often been sighted in depths of less than 2 m (6.6 ft) (Read et al. 2003b, 2003c, 2003d). Previous research (Read et al. 2003d) also indicates that this species is commonly encountered in waters adjacent to the BTs. Thus, protective measures will be tailored to focus on areas where this species has previously been recorded.

- Pre- and post-exercise monitoring of the target area would be conducted using visual surveys.

- A range cannot be used if a protected species is sighted within 914 m (3,000 ft) of the BTs or anywhere within Rattan Bay. Operations may not commence until the animal(s) have moved away from or outside the restricted areas of the in-water BTs (NMFS 2002).

- Standard operating procedure (NMFS 2002) for pilots is to perform a visual check prior to ordnance delivery to ensure that unauthorized civilian vessels, personnel, or protected species are not present in the target areas. Pilots are directed to perform a low, “cold” (no ordnance delivered) pass. Prior to granting a “First Pass Hot” (use of ordnance) to the aircrew, range personnel make every attempt to clear the area via visual inspection and remotely operated camera operations. The Range Controller may deny or approve the First Pass Hot clearance as conditions warrant.

- To visualize animals at the surface or breaking the surface, high-resolution (e.g., allows one to clearly see a duck floating near the target) remotely operated range cameras are used (it is not possible to see beneath the water surface, so submerged species are not detectable).

- For operations that occur after daylight hours, either real-time passive acoustic monitoring, via sonobuoy or hydrophones, acoustic deterrent devices (pingers), or active acoustic detection will be used, including:

    - Development and test of a real-time passive acoustic monitoring (listening for marine mammal sounds) system.

- Acoustic deterrent devices that produce sound (e.g., Dukane NetMark™ 1000 [fundamental frequency 10 to 12 kHz, sound pressure level 132 dB re: 1 μPa, pulse duration of 300 msec]) have been demonstrated to be an effective means in repelling delphinids (Barlow and Cameron 2003).

- Active acoustic detection involves using sound to detect an animal. Target strengths (reflection energy) have been identified for some small cetaceans (i.e., spinner dolphins [*Stenella longirostis*] and dusky dolphin [*Lagenrhynchus obscurus*]) using common fish finders (i.e., Computrol Tournament Master Fishfinder NCC 5300) (Benoit-Bird and Au 2003; Benoit-Bird et al. 2004). The advantage of active acoustic detection is that an animal does not need to be producing sound in order to be identified.

7.1 ADDITIONAL MEASURES CONSIDERED

Protective measures will include thorough monitoring of the impact area before, during, and after the event, in addition to establishing a sequence of procedures to achieve the least practicable adverse impacts on protected resources. Other mitigation alternatives considered during development of the protective measures described in Section 8.0 but dismissed because of their impact to military readiness, include:

- Since the ranges operate continuously and the bottlenose dolphin population is presumed to be stable throughout the year, time or seasonal restrictions on the use of explosive ordnance are impracticable and would severely compromise training flexibility. The use of explosive ordnance use is permitted at BT-9 at any time during the year, although the majority of the explosive ordnance use occurs during large training exercises. Two to three of these large exercises occur throughout the year (they do not occur more heavily in any one season).

- Visual monitoring of the impact area using a boat or vessel would not be possible due to personnel safety.

8. MONITORING AND REPORTING MEASURES

As described in the previous section, the Marine Corps will monitor the bombing ranges to reduce the potential impacts to marine mammals. Information associated with the presence of any marine mammals observed during training, including the number, general location of animals, and time of sighting will be recorded. The compiled sighting information and description of any action taken will be maintained by MCAS Cherry Point.

Any observations of stranded or injured marine mammals within the BT-9 and BT-11 vicinity will be immediately reported to the NMFS stranding network. MCAS Cherry Point personnel will be responsible for ensuring that the MCAS local Chain of Command and the MCI-East are notified of any occurrence.

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9. RESEARCH

In an effort to improve the availability of data on the abundance and seasonal distribution of marine mammals in the BTs, the MCAS Cherry Point has provided funding support to augment the surveys conducted by the NMFS Southeast Fisheries Science Centers. For example, to provide additional information on the distribution and abundance of marine mammals and sea turtles in the mid-Atlantic region, the NMFS Southeast Fisheries Science Center has been contracted by the MCAS to conduct aerial surveys covering the R-5306A restricted airspace that encompasses portions of Pamlico and Core Sounds (Goodman et al. 2004, 2005a, 2005b, 2005c). Previous access to these areas has been restricted, but these studies are providing valuable information on the use of this region by protected species and may provide seasonality information that could be used to plan exercises to least impact protected species.

The three objectives of these studies are to:

1. Survey the waters of Core and Pamlico Sounds within the R-5306A airspace and document seasonal distribution and number of sea turtles and marine mammals over a 16-month period (Final report was expected in February 2006);
2. Provide an index of abundance for the protected species that can be compared among seasons; and
3. Provide observer training to MCAS Cherry Point personnel sufficient to allow these personnel to perform pre-and post-exercise surveys for protected species.

The MCAS Cherry Point has funded sighting surveys performed by Duke University from July 2002 to June 2003 targeting common bottlenose dolphins. These boat-based surveys additionally photo-identify sighted dolphins and dolphins identities are compiled and cataloged by Duke (Read et al. 2002, 2003b, 2003c, and 2003d). The MCAS has also contracted Duke University to conduct acoustic monitoring studies of the use of BT-9 and BT-11 by common bottlenose dolphins. Since August 2005, two pop-up hydrophone buoys have been deployed in BT-9 and one at Rattan Bay of BT-11 (Urian 2005a, 2005b).

The MCAS Cherry Point has funded additional work with Duke University to develop and test a real-time passive acoustic monitoring system that will allow automated detection of bottlenose dolphin whistles. The work willormed in two distinct phases. Phase I will develop an automated signal detector (a software program) to recognize the whistles of dolphins in the BT-9 and BT-11 ranges. Phase II will assemble and deploy a prototype real-time monitoring unit on one of the towers in the BT-9 range. The success of this effort will help direct future monitoring initiatives and activities within the BTs.

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10. IMPACT TO CETACEAN SPECIES OR STOCKS

This section addresses potential impacts to marine mammal species or stocks from underwater noise and inert munitions (Figure 10-1 and Table 10-1). Based on the best available science, the USMC concludes that exposures to marine mammal species and stocks would result in only short-term effects and would not affect annual rates of recruitment or survival based on the analysis presented in the previous chapters.

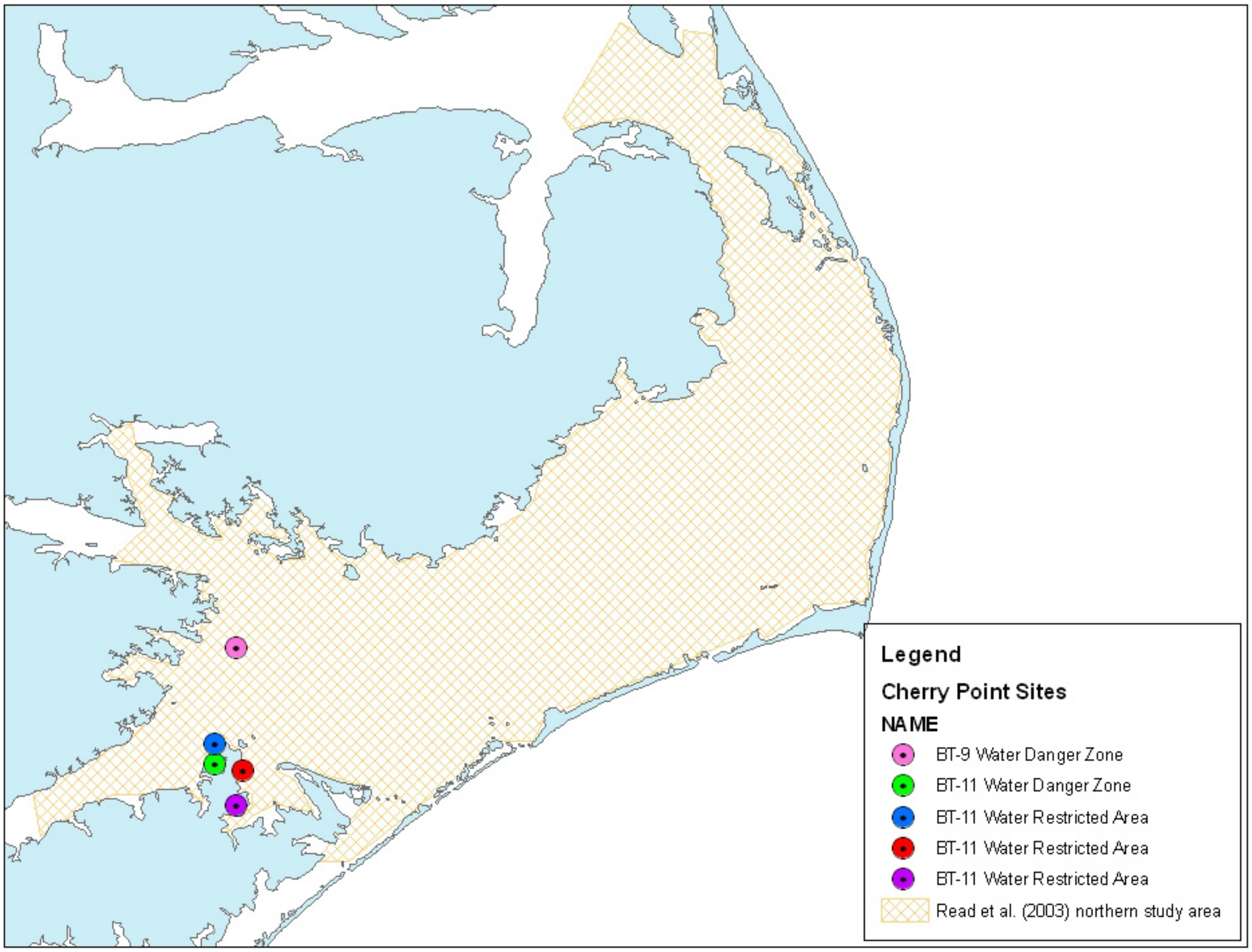

Figure 10-1. The Read et al. (2003) Bottlenose Dolphin Study Area Used to Calculate Density.

Table 10-1. Density of Marine Mammals in the Cherry Point Sites Area

Common Name	Species Name	Status	Density (animals/km2)	Season	Depth (<10 m)
Bottlenose dolphin	*Tursiops truncatus*	Not listed	0.183[1]	year round	100 percent of bottlenose dolphin time would be at <10 m

[1] Read et al. (2003a)

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